MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

EMT2036 – ENGINEERING MATHEMATICS 3

(All Sections / Groups)

21 OCTOBER 2019

9:00 A.M. – 11:00 A.M.

(2 Hours)

INSTRUCTIONS TO STUDENTS:

1. This exam paper consists of **4 pages** (including cover page) with **4** Questions only.

2. Attempt **all** 4 questions. All questions carry equal marks and the distribution of marks for each question is given.

3. Please print all your answers in the Answer Booklet provided. Show all relevant steps to obtain maximum marks.

4. The required statistical book is provided.

Question 1

(a) A dummy is used in the frontal offset crash test to gather the information on the mean of impact velocity. In 10 crashes, the impact velocities are obtained as below. The measurements are normally distributed.

65	47	51	54	70
55	45	48	59	53

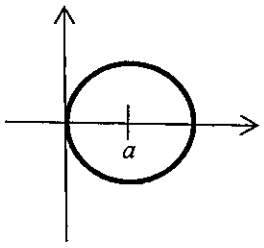
(i) Construct a 95% confidence interval for the overall mean of the impact velocity. [7 marks]

(ii) Using test statistics approach at 0.01 significance level, test whether the mean of the impact velocity is statistically different from 50.2 if it is known that the standard deviation is 8. [6 marks]

(b) Consider the following double integrals:

$$\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_{0}^{2a\cos(\theta)} (r\sin\theta)\, r\, dr d\theta,$$

where $r = 2a\cos(\theta)$ is a circle with radius a and center at $(a,0)$, as shown in the following figure.



(i) Evaluate the above integrals. [6 marks]

(ii) Give the region of integration described by the double integrals. [3 marks]

(iii) Change the order of integration for the double integrals (**Do not evaluate** the integral). [3 marks]

Continued...

Question 2

(a) Show that the vector $\mathbf{F}(x,y,z)=(y^2+2xz)\mathbf{i}+2xy\mathbf{j}+x^2\mathbf{k}$ is conservative, and hence evaluate the line integral $\int_C \mathbf{F}\cdot d\mathbf{r}$ where C is the straight line from $(1,1,1)$ to $(2,3,2)$. [9 marks]

(b) Use Green's theorem to evaluate the line integral

$$\int_C y^2dx+x^2dy,$$

where C is the positively oriented closed curve comprised of line segments connecting $(0,0)$, $(1,0)$ and $(0,2)$. [7 marks]

(c) Use Divergence Theorem to find the outward flux of $\mathbf{F}(x,y,z)=y^2\mathbf{i}+y^2\mathbf{j}+z\mathbf{k}$ across the surface σ of a solid bounded by $2x+2y+z=2$, $x=0$, $y=0$ and $z=0$. [9 marks]

Question 3

(a) Given $A=\begin{bmatrix}1 & 0 & 1\\ -2 & 1 & -1\\ 4 & -2 & 3\end{bmatrix}$.

(i) Determine the inverse of matrix A using elementary row operation. [10 marks]

(ii) By using the results obtained from part (i), find $(3A)^{-1}$. [4 marks]

(b) Solve the following system of linear equations by using Cramer's rule.

$$\begin{aligned}4x+4y&=3+5z\\ x+2y-4z&=-6\\ 4x&=1-y+z\end{aligned}$$

[11 marks]

Continued...

Question 4

(a) Given $A=\left[\begin{array}{cc|cc} 2 & -3 & 1 & 0 \\ 1 & 5 & -2 & 3 \\ \hline 0 & -4 & -2 & 7 \\ 4 & 0 & 2 & 1 \end{array}\right]=\begin{bmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{bmatrix}$ and $B=\left[\begin{array}{cc} 6 & 3 \\ 2 & -1 \\ \hline 3 & 5 \\ 5 & 3 \end{array}\right]=\begin{bmatrix} B_1 \\ B_2 \end{bmatrix}$.

Compute AB using block multiplication. [10 marks]

(b) Let $A=\begin{pmatrix} 3 & 2 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 3 \end{pmatrix}$. Given that $\begin{pmatrix} -1/2 \\ 1 \\ 0 \end{pmatrix}$, $\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 1/2 \\ 1 \end{pmatrix}$ are eigenvectors of A corresponding to the eigenvalues $\lambda_1=-1$, $\lambda_2=-1$ and $\lambda_3=8$, respectively. By using these information, find the solution of the following system of differential equations where x_1, x_2 and x_3 are functions of t and $x_1(0)=x_2(0)=0$ and $x_3(0)=3$.

$$\begin{aligned} x_1' &= 3x_1+2x_2+4x_3 \\ x_2' &= 2x_1 \qquad +2x_3 \\ x_3' &= 4x_1+2x_2+3x_3 \end{aligned}$$

[15 marks]

End of paper.